Volume 34 February, 1948 *Number 2*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of
Food Preservation
Machinery

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

Reduce CHASSIS MAINTENANCE COSTS

NOW INCREASE THE MILEAGE BETWEEN CHASSIS LUBRICATIONS... ASSURE FEWER REPAIRS AND REPLACEMENTS!

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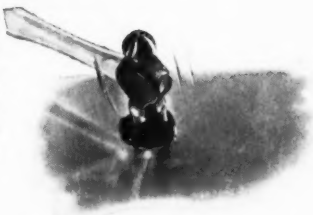
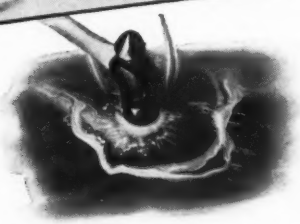
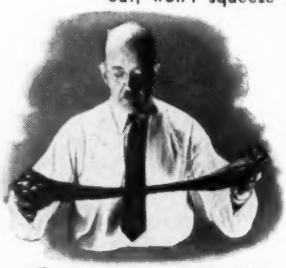


1 **MARFAK PROTECTS LONGER.** Hit it as hard as you can, Marfak won't splatter. Just so, it stays in chassis bearings — won't jar out, won't squeeze out.

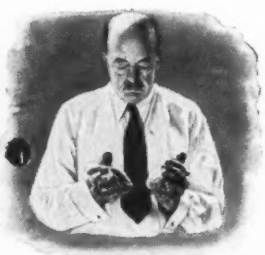


2 **ORDINARY GREASE FAILS** to protect. Splatters under even a light blow—a sure sign bearings would soon be left without full protection.

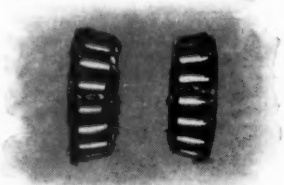


3 **MARFAK STRETCHES LIFE** of parts It's cohesive, holds together, enabling Marfak to seal out dirt and moisture while providing full lubrication.

More than 275 million pounds of MARFAK have been used to date



4 **ORDINARY GREASE LACKS** cohesion, has no stretch. It works out of bearings, drops off—thus fails to protect, lets in dirt and moisture. Result: extra expense for frequent greasings, repairs and parts replacements.



5 **MARFAK HEAVY DUTY** protects wheel bearings for extra thousands of miles. It stays *in* the bearing — assures safer braking, requires no seasonal repacking.

Call on Texaco Lubrication Engineering Service for helpful suggestions on cutting chassis maintenance costs. Contact the nearest of the more than 2500 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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FOR ALL TRUCKING EQUIPMENT

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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LUBRICATION OF FOOD PRESERVATION MACHINERY

MAN has depended upon food ever since the Garden of Eden. Down through the ages this dependence taxed him physically but rarely mentally. He simply picked his fruit requirements from trees or bushes, grubbed up such root vegetables as he had learned were palatable, and went into the forests or plains to kill for his meat requirements. Conservation was furthest from his thoughts, if he had any thoughts. It was a day to day subsistence, often hazardous as he was competing with savage animals for much of this same food. There was no saving for the next meal, leftovers were left where discarded.

There was some merit to this procedure. Prehistoric man was always sure his foods were fresh. His diet was simple, as it was given no serious thought; the pangs of hunger controlled his physical efforts to obtain the foods he craved. All the while he ate his food raw. Cooking was a procedure which accompanied man's ability to make and control fire. Cooked foods not only tasted better but also could be stored at least from one meal to another. Then man began to use his mental as well as his physical prowess regarding his diet. The preservative effects of drying by heat were utilized further when man found he could smoke or sun-dry fish and strips of meat and keep them for a considerable period of time. Then he was able to "pack a lunch" and travel further from his base of food supply.

During these travels he probably discovered the cool nature of underground caves, how refreshing were the waters from mountain springs. His growing mental process probably likened this to the snow and ice of winter when he had traveled sufficiently far into the northern zones. Then he learned of the preservative ability of ice by having to leave a kill buried in snow, to return to it after a storm had passed.

History records no attempt to control food and beverage temperatures until the ancient Greeks and Egyptians discovered that temperature could be reduced by evaporation of water. The actual use of ice or snow for controlled food preservation, however, is said to date back to the Roman Caesars when Nero had snow carried by slaves from the Appenine Mountains and stored in insulated trenches to cool the wines and preserve the table delicacies which were served at his banquets.

Natural ice continued to be used for food storage and preservation in a more wide-spread manner as civilization advanced. The development of transportation facilities was a factor in this extension and when the insulating properties of hay, straw, sawdust and cork were discovered the familiar icehouse of the last century became a prominent feature on the shoreline of most of the northern ponds and lakes. Ice production was still a natural job, however, until engineering talent perfected the ammonia compressor. From this application of the principles of compression, expansion and evaporation of certain chemicals has developed the modern refrigeration machinery which is such a vital factor today in food storage and distribution.

Food preservation by refrigeration can be divided into two stages i.e.

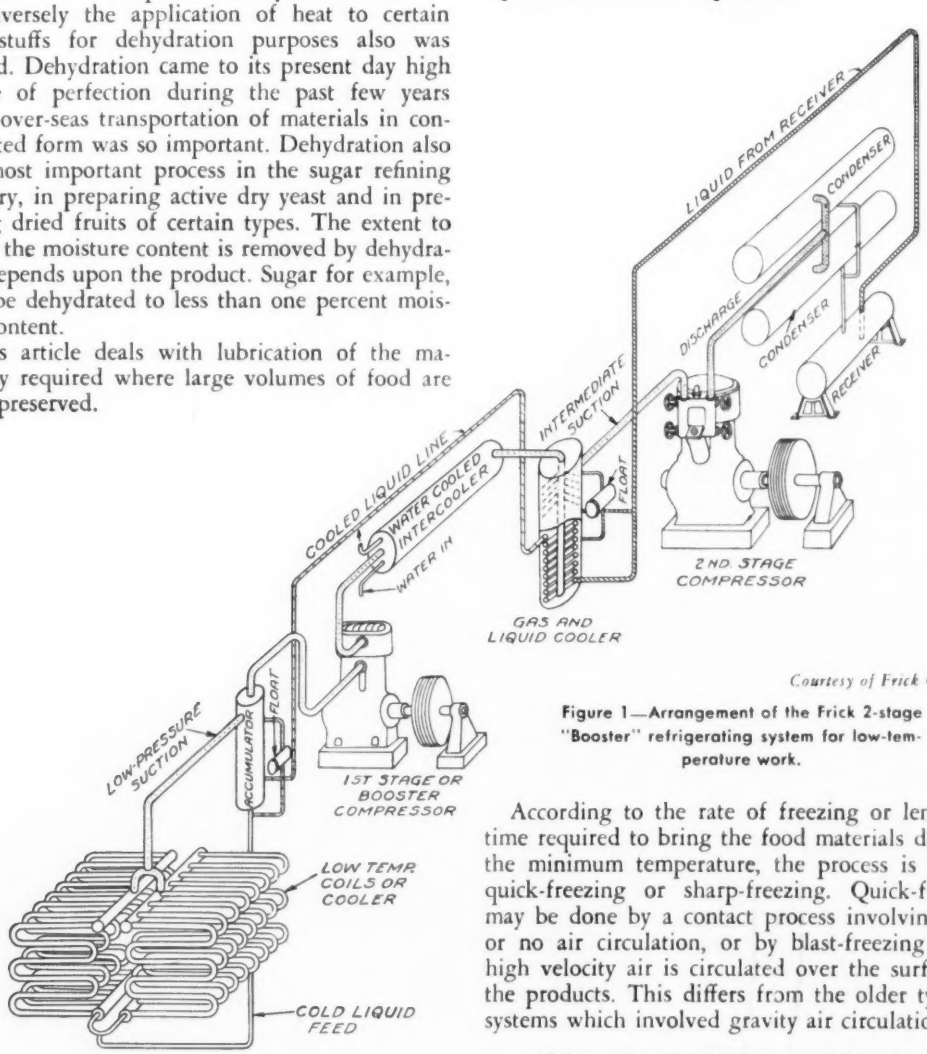
(1) as involving large volume processing apparatus, materials handling equipment and refrigeration machinery in preparation of foods for the market and,

(2) as involving subsequent more or less short time storage at the temperatures customarily involved in the domestic refrigerator.

The principles of refrigeration are the same for both; the same types of lubricating oils also are used for compressor lubrication except that in some unit systems the temperatures may be lower.

Conversely the application of heat to certain food stuffs for dehydration purposes also was studied. Dehydration came to its present day high degree of perfection during the past few years when over-seas transportation of materials in concentrated form was so important. Dehydration also is a most important process in the sugar refining industry, in preparing active dry yeast and in preparing dried fruits of certain types. The extent to which the moisture content is removed by dehydration depends upon the product. Sugar for example, must be dehydrated to less than one percent moisture content.

This article deals with lubrication of the machinery required where large volumes of food are to be preserved.



Courtesy of Frick Company

Figure 1—Arrangement of the Frick 2-stage "Booster" refrigerating system for low-temperature work.

THEORY OF THE FREEZING PROCESS

This problem of food preservation has required extensive research to ascertain the cell structure of foods and the effect which heat or quick-freezing may have upon this cell structure. All foodstuffs contain moisture. Satisfactory preservation is obtained by congealing this moisture to crystalline form by quick-freezing to stop chemical and bacterial activity as far as possible.

The size of these crystals is most important. When relatively large crystals are formed in the cell structure the latter may be ruptured, to affect the taste and natural texture of the product. The slower the freezing process the larger the crystals. Hence the intensive research which was devoted to perfecting the freezing process in order to promote as rapid heat-transfer as possible.

According to the rate of freezing or length of time required to bring the food materials down to the minimum temperature, the process is termed quick-freezing or sharp-freezing. Quick-freezing may be done by a contact process involving little or no air circulation, or by blast-freezing where high velocity air is circulated over the surfaces of the products. This differs from the older types of systems which involved gravity air circulation.

THE MACHINERY REQUIRED

The freezing plant can be stationary or portable. A highly mobile refrigeration-packing unit has been developed. Vegetables, fish and certain meat products are seasonal; they do not conserve their flavor if allowed to age, hence they must be quick-frozen as soon as possible after harvesting or dressing. Fish, peas, shell food and strawberries are especially perishable. So a mobile freezer can well be a transient which may be set up in a dozen localities in the course of a season.

This feature of portability is a definite advantage to the packer. Normally in setting up such a plant, he is only concerned with power and water supply. It may prove a headache to the lubricating engineer, however, due to varying cooling water temperature conditions. Furthermore, he must provide for wide (and perhaps temporary) distribution of his specialty refrigerator oils for compressor lubrication.

Compressor Design

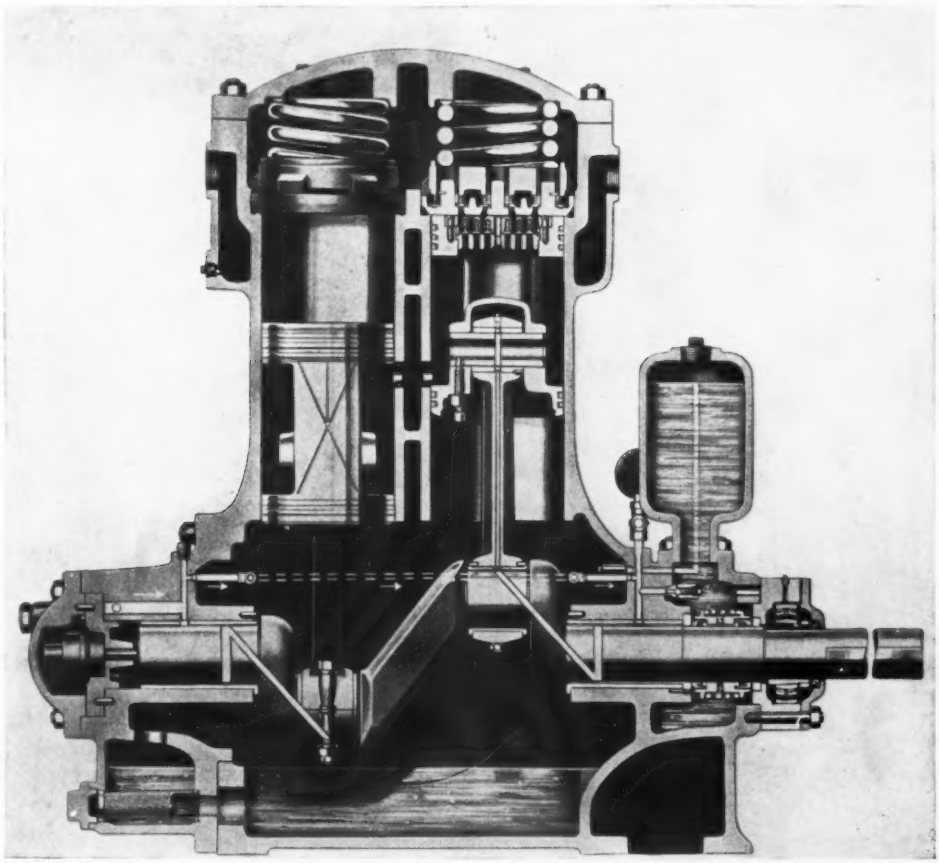
The vertical, reciprocating, enclosed trunk-type refrigerating compressor so familiar in the manufacture of ice is quite generally used for quick-freezing and for maintenance of the required cold conditions in locker storage. In other words, refrigeration by compression is practiced. Such a system includes a compressor, oil separator, condenser, receiver, expansion valve, and an evaporator or refrigerator.

In the compression process the refrigerant or cooling agent is recovered after each expansion by means of mechanical compression. With certain variations in construction and arrangement of equipment, the compression process is adaptable to any one of the modern accepted refrigerants.

In service, the gaseous refrigerant must be sufficiently compressed and cooled to convert it to liquid form. Under compression alone, it will still remain as a vapor due to the fact that the application of pressure raises the temperature above the liquefaction point. So some form of condenser is necessary.

Prior to condensation, however, the gas is usually passed through a suitable oil separator or trap in an attempt to free it of any excess lubricant that may have passed over from the compressor cylinders. From the oil separator the hot refrigerant then passes to the cooling coils of the condenser where its temperature is sufficiently lowered by means of air or cold circulating water to convert it to liquid form. It is then capable of cooling.

This latter is brought about by passing the re-



Courtesy of The Vilter Manufacturing Company

Figure 2 — Details of a Vilter booster compressor showing features of the oiling system.

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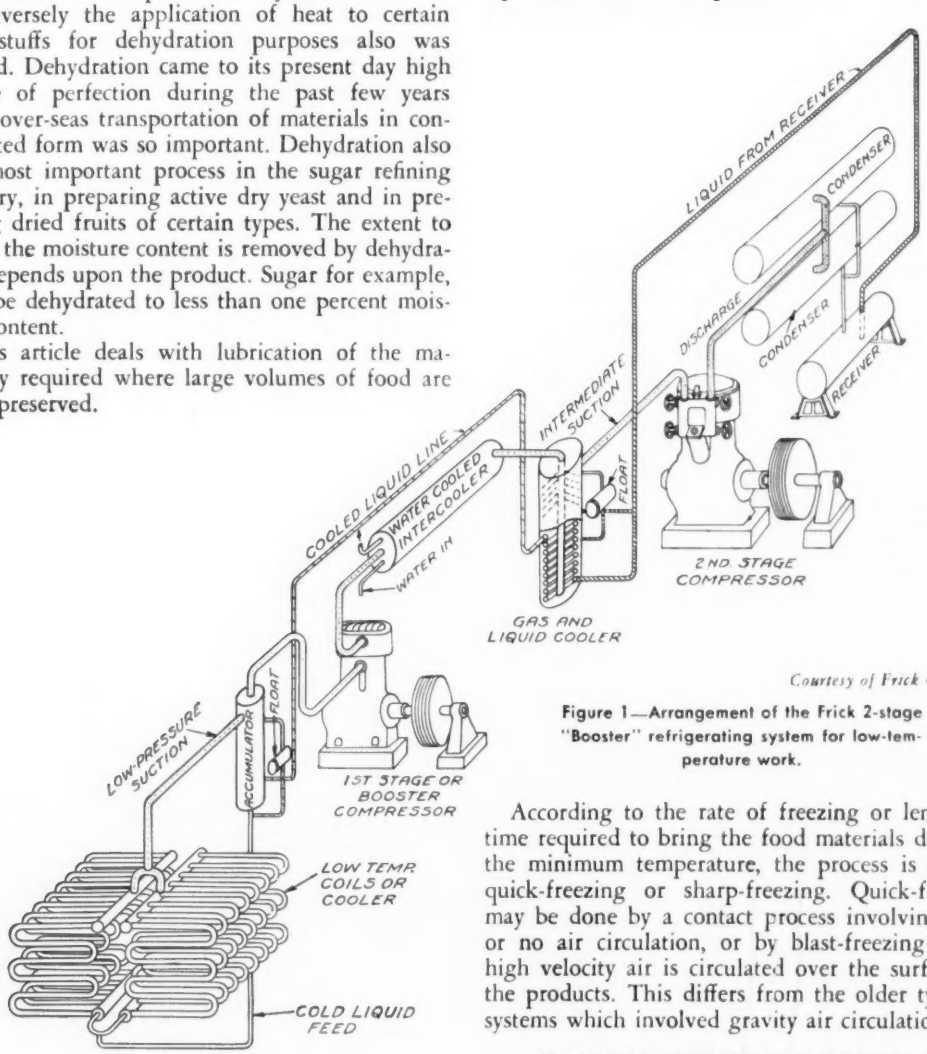

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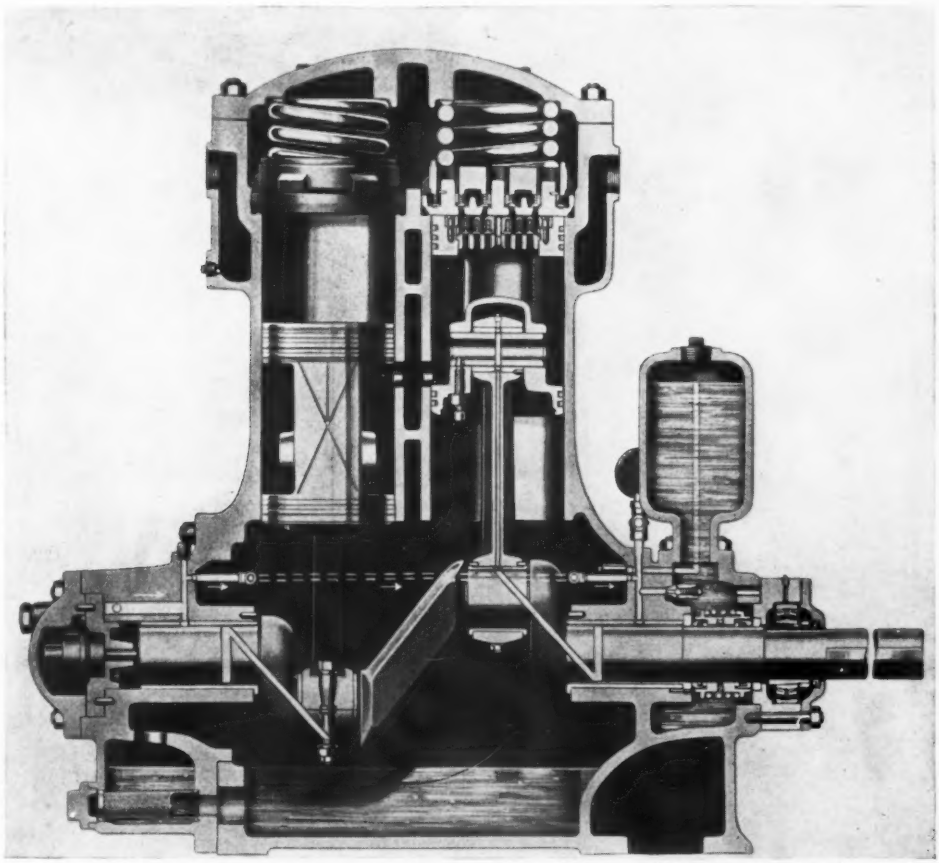

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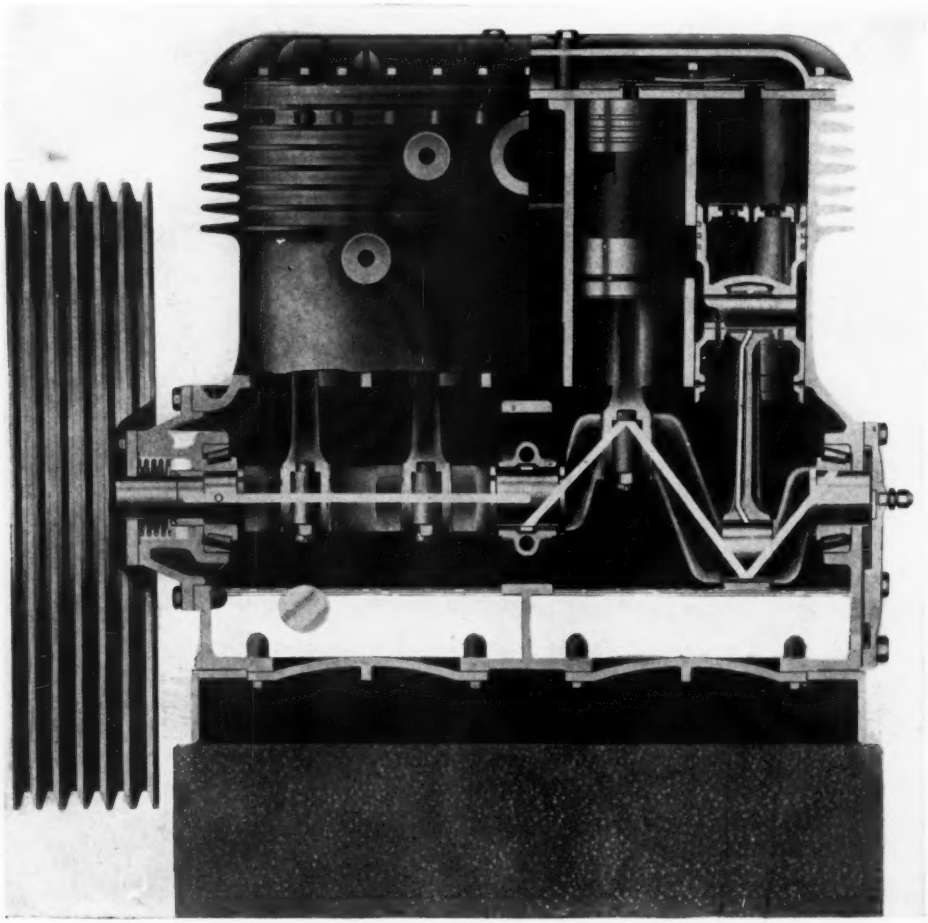
frigerant through an expansion or regulating valve to the evaporating side of the system. Here, because of the naturally lower temperatures established, it evaporates and takes up heat, returning thereafter to the gaseous state. In so doing, it cools down to a relatively low temperature, and as a result, absorbs heat from the material to be cooled or frozen. The refrigerant is then returned to the compressor for repetition of the cycle.

and maintain a lower final discharge gas temperature than would otherwise be possible.

Some refrigeration installations use single stage compressors over a wide range of compression ratios, with the inevitable high temperature discharge gas due to such design. If in order to obtain low temperature evaporator conditions, a booster compressor is added to this system without the use of a desuperheater or inter-cooler, the temperature



Courtesy of Baker Ice Machine Company, Inc.

Figure 3 — Sectional view of a Baker "Freon" compressor showing how the machinery is designed for lubrication.

The Inter-Cooler

The use of an inter-cooler between compressor stages is essential on a two-stage machine, or where a booster compressor is used in connection with an existing refrigerating machine. This inter-cooler desuperheats the discharge gas of the booster or the low pressure stage, thus allowing the succeeding compressor cylinder to operate at greater efficiency

of the final discharge gas may be so high as to cause carbonization of the lubricating oil.

Cooling Water Temperature

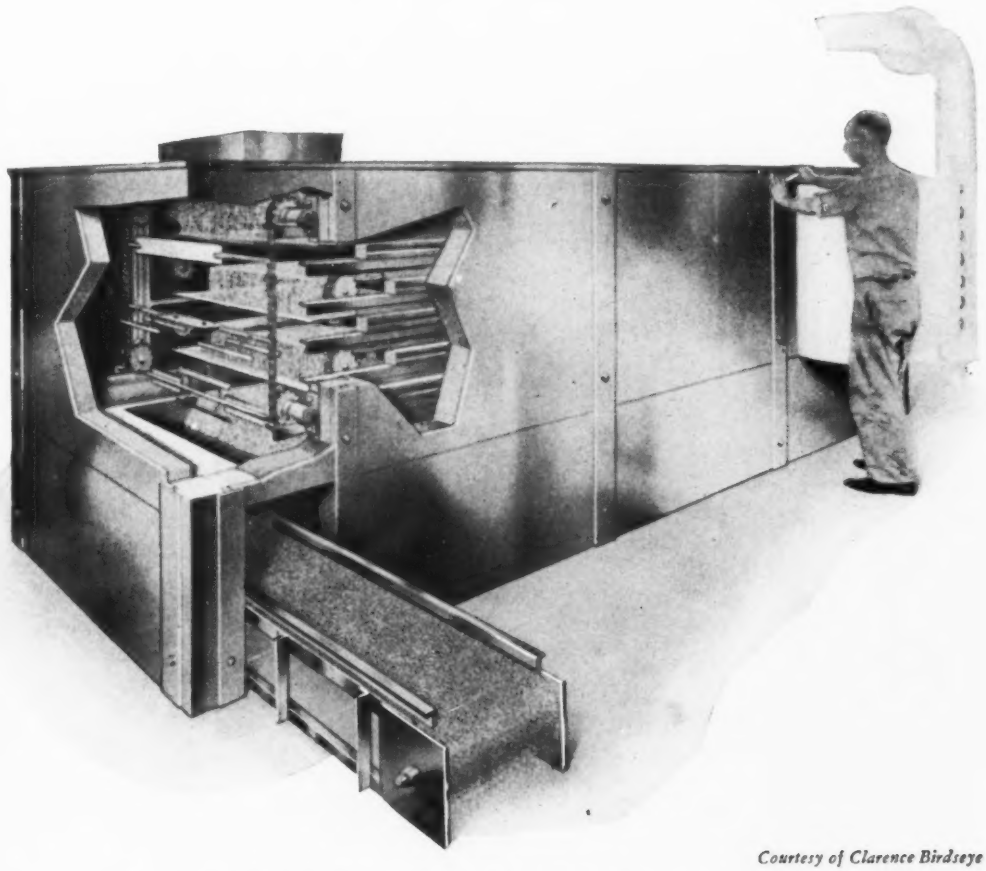
Quick freezing may require exacting duty from the oil used for compressor lubrication, according to the temperature of the cooling water. The latter will have a definite effect upon the discharge tem-

perature and hence the amount of heat to which the lubricating oil will be exposed on the cylinder walls and during the course of carry-over by the refrigerant. This must be considered when selecting the oil, whenever the popular type of portable quick freezing unit is involved.

The process is applicable from the Gulf Coast to Canada. Obviously, water conditions will vary widely, for the well water of Maine will be much cooler than the normal river or stream water of Florida; and in between these ranges there may be almost as much variation according to the source minus 50 degrees Fahr., to insure against congealing in the evaporator or at the expansion valve.

LOW TEMPERATURES REQUIRE THOUGHTFUL LUBRICATION

To attain the desired degree of freezing within the time specified for the food products under treatment, the quick-freezing process must be carried out at temperatures as low as 45 to 50 degrees below zero Fahrenheit. The oils for compressor lubrication must give dependable protection and resist carry-over with the refrigerant to the heat



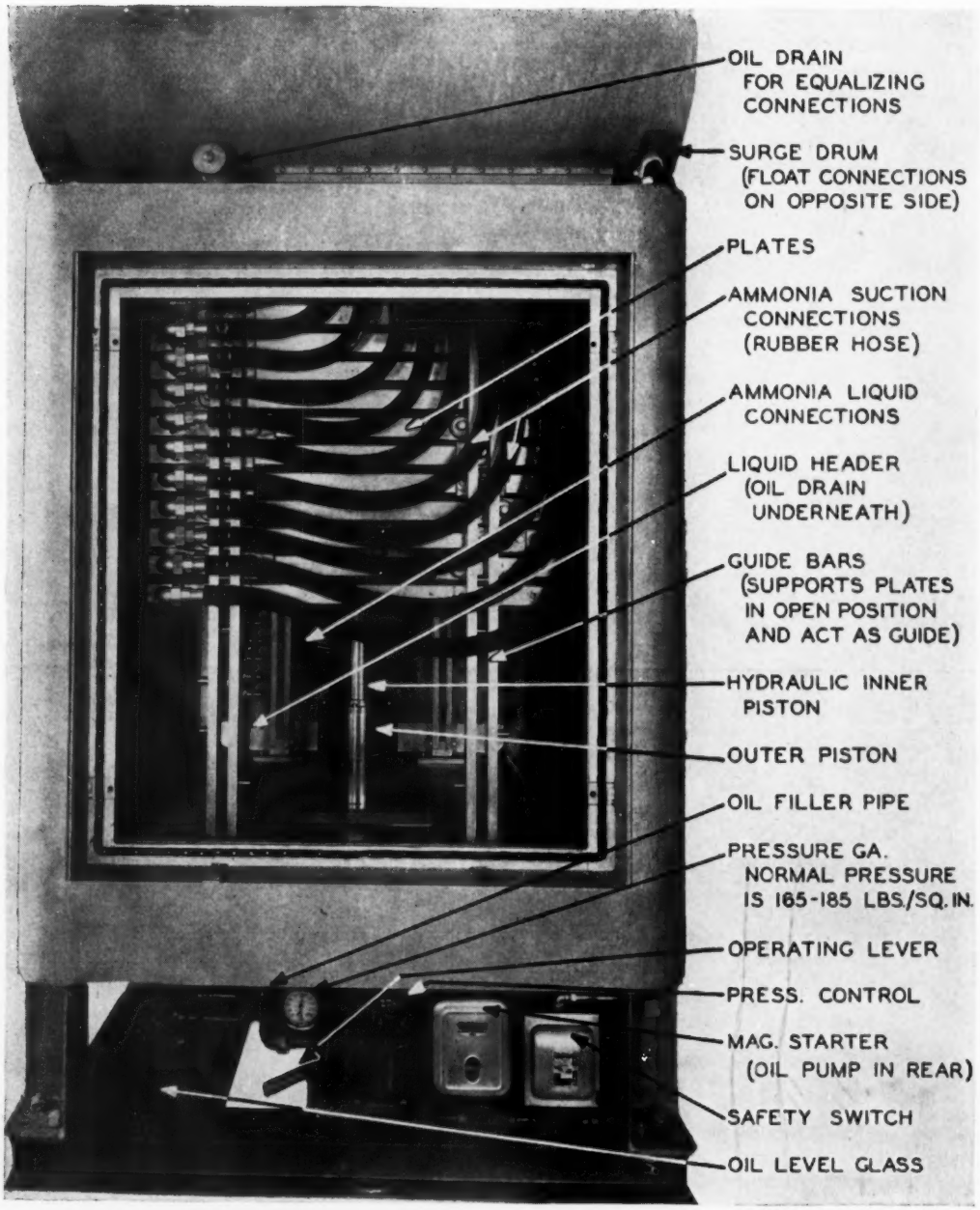
Courtesy of Clarence Birdseye

Figure 4 — Details of the Birdseye Gravity Froster designed to use rectangular plates.

or amounts of water available. The economy of the refrigerating system as well at its capacity is affected by high water temperatures. This will enable adequate heat transfer and yet, not too high an outlet temperature. The latter is desirable where cooling towers or heat exchangers must be employed to enable re-usage of the water supply.

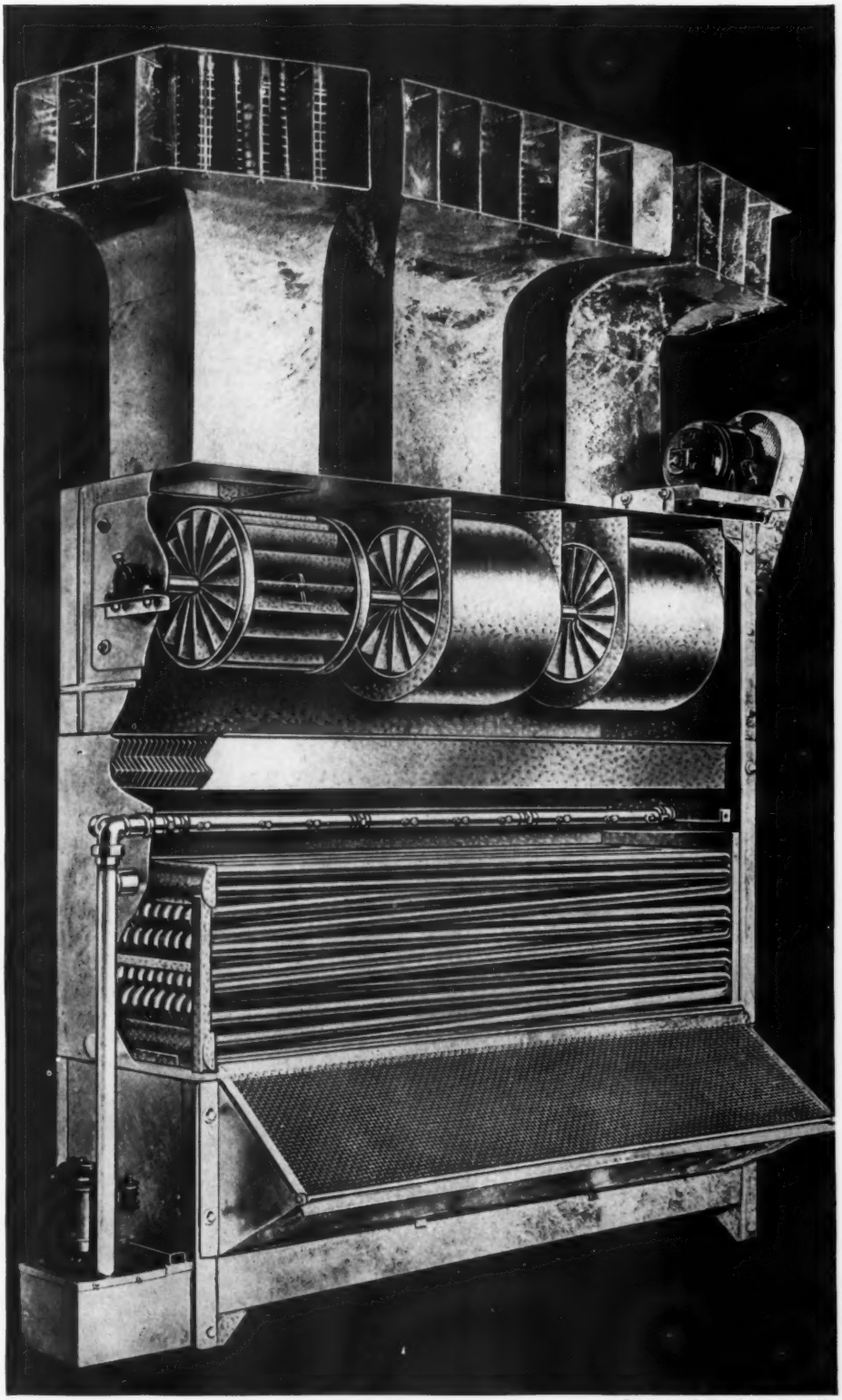
So the compressor oil may have to meet almost automotive conditions on the high side, and yet possess ample fluidity at temperatures as low as exchange parts of the system. As this heat exchange subjects any oil present to quite as low temperatures as are brought about by expansion and evaporation of the refrigerant, the oil must contain no component which will congeal in sufficient volume to remain on the expansion valve or within the evaporator. This will cause faulty operation of the valve and reduce the subsequent rate of heat transfer in the evaporator.

In quick-freezing refrigeration, ammonia is most


OIL DRAIN FOR EQUALIZING CONNECTIONS
SURGE DRUM (FLOAT CONNECTIONS ON OPPOSITE SIDE)
PLATES
AMMONIA SUCTION CONNECTIONS (RUBBER HOSE)
AMMONIA LIQUID CONNECTIONS
LIQUID HEADER (OIL DRAIN UNDERNEATH)
GUIDE BARS (SUPPORTS PLATES IN OPEN POSITION AND ACT AS GUIDE)
HYDRAULIC INNER PISTON
OUTER PISTON
OIL FILLER PIPE
PRESSURE GA. NORMAL PRESSURE IS 165-185 LBS/SQ.IN.
OPERATING LEVER
PRESS. CONTROL
MAG. STARTER (OIL PUMP IN REAR)
SAFETY SWITCH
OIL LEVEL GLASS

Courtesy of Birdseye-Snider Div. General Foods Corp.

Figure 5 — Structural features of General Foods multiplate freezer 10-station type (patented).



Courtesy of Carrier Corporation

Figure 6 — The Carrier Spray type Cold Diffuser in which a gentle steady flow of forced cold air serves as the cooling medium. Bearings are greased-packed self-aligning ball bearings mounted in adjustable housings which are readily accessible.

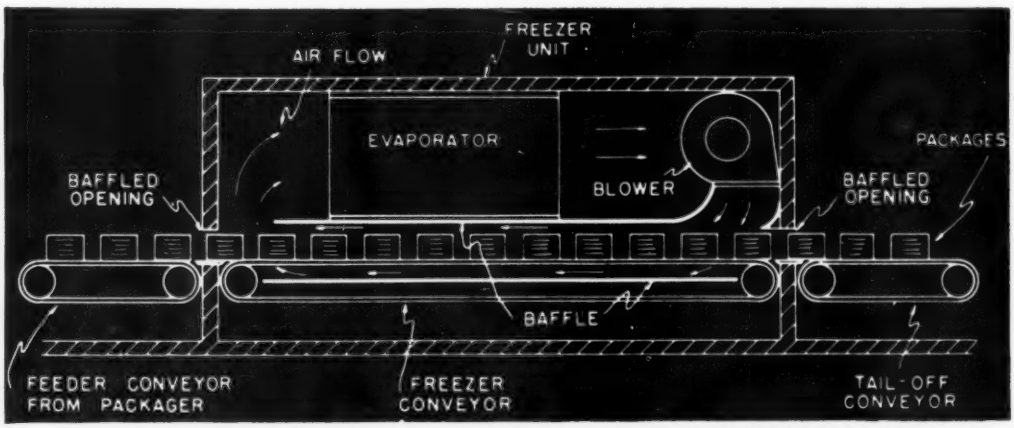
widely used. With this chemical, oil trap or separator installations can be practically designed, for the oil is present in the high-side in the liquid phase, although it may be in very finely dispersed form.

Ammonia forms a physical mixture with hydrocarbon lubricating oils in which it is essentially insoluble. Other refrigerants, which are soluble require very careful consideration from this point of view — notably the fluorinated and chlorinated "Freons," Carrene and methyl chloride. These refrigerants tend to reduce the viscosity of the oils with which they go into solution. Oil and refrigerant mixtures are hard to break even with the most efficient oil separators available; hence the usual precautions to keep the components apart wherever possible.

pressors without inter-coolers are employed the compression temperature may approach 300 degrees Fahrenheit on the discharge side. This, however, should cause no concern, since in normal service the average high-quality compressor oil will not show appreciable evaporation at such temperatures. As ordinarily understood, the flash point is a rough measure of evaporation. There is no fire hazard involved because there is no source of ignition and no air present in closed systems to support combustion.

THE OIL CHARACTERISTICS

The Petroleum industry uses the utmost care in selecting the crude oil stocks from which refrigerator oils are refined. Stability under high temperature



Courtesy of The Vilter Manufacturing Company

Figure 7 — Schematic cross-section of a freezer tunnel showing belt conveyor method of handling pre-packaged food products.

How Quick Freezing Temperatures Affect Oil Selection

By reason of the unusually low temperatures required in quick-freezing operations the compressor oil should be capable of meeting these without wax congealing or ice forming at the expansion valve, and without deposition in the evaporator. This requires an oil which is virtually free from water and one which shows a sufficiently low pour test to assure of only the necessary amount of paraffinic hydrocarbons to give balanced lubricating ability. The viscosity should normally range from 150 to 300 seconds Saybolt Universal, according to compressor design and the operating conditions.

The other physical characteristics are of little concern to the operator; they have no bearing upon the lubricating ability of a refrigerating compressor oil and may only be indicative of the type of crude from which the oil has been produced. In quick-freezing service where single-stage or booster com-

conditions in turn is assured by the use of selective solvents for removing the unstable hydrocarbon components during the course of refining. The result has been the development of a series of processes capable of producing the type of refrigerator oil today which is ideally suited to the operating conditions.

This superiority is evidenced to the refrigerating plant operator by more dependable performance, and the normal absence of an excess of objectionable deposits.

The chemist denotes this superiority by comparing physical specifications, and the use of certain accelerated service tests. These latter are based upon resistance to oxidation and normally subject the oil to controlled and elevated pressure and temperature conditions in an atmosphere of oxygen. An oil which will resist the precipitation of sludge or gummy matter under such conditions will function satisfactorily in the presence of any of the refrigerants generally used today. In other words,

the oil will meet the requirements of the refrigeration industry.

The operator must respect these facts when selecting his operating conditions, with full appreciation that lubrication of the refrigerating compressor is unique in that the effect of petroleum oils upon parts not requiring lubrication is quite as important as the lubricating ability. In other words, he must look beyond the compressor and consider what may happen if his oil becomes so sluggish, when carried over by the refrigerant to the expansion coils, as to congeal therein and reduce the rate of heat transfer and the refrigerating capacity. This requires knowledge not only of the pour test of the oil he may be considering, but also the minimum temperatures which may prevail in the evaporator.

Significance of the Pour Test

The physical effect of temperature is an interesting phenomenon when considered with respect to various fluids. In the case of petroleum oils it is not the same as with the more simple fluids such as water, alcohol or glycerine. Petroleum oils, being complex combinations of hydrocarbons of various melting or freezing points, behave like solutions and frequently certain of the constituents will congeal as the temperature is lowered, before solidification of the entire mixture.

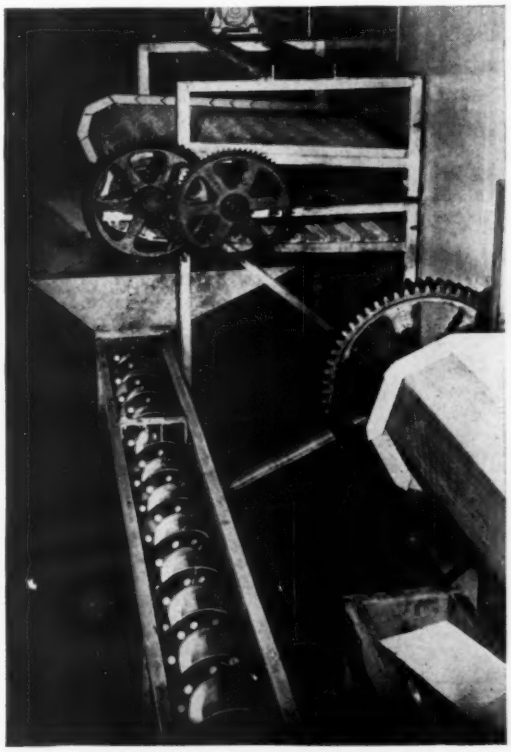
These are interesting phenomena which can only be explained by change in physical structure of the hydrocarbon constituents. They are the reasons why such infinite care must be taken in observing the pour test of an oil under standardized conditions, and why check results by different laboratories are so often difficult to obtain. Just slight variation in the rate of cooling or the least agitation or stirring may affect the results. Even the preheating of a sample by carrying it in a closed car on a hot summer day may throw the subsequent laboratory results off to some extent. In other words, the pour test is only a comparative value due to the method of test being designed to cover a variety of variables.

It is especially important for the laboratory to avoid stirring or agitation while cooling as movement of oil destroys or changes the fine network of microscopic particles of paraffinic bodies which are separating out. Authorities feel that an oil which is stirred will solidify at lower temperature and hence show a false pour test.

The pour test is not significant when the oil is used in conjunction with a refrigerant in which it is soluble. In this case, the important factor is whether or not wax or heavy oil molecules will precipitate from the oil-refrigerant mixture at the lowest temperature encountered, and thus deposit to plug orifices or coat evaporator coils.

Viscosity a Function of Operating Conditions

Compressor lubrication in quick freezing service, requires consideration of the oil viscosity from a constructional and operating viewpoint. The oil is not subject to appreciable viscosity-reduction when mixed with ammonia as occurs with the chlorinated or fluorinated types of refrigerants. Oil film formation and maintenance on cylinder walls



Courtesy of Link-Belt Company

Figure 8—Two Link-Belt galvanized wire-mesh main freezing conveyors delivering frozen product to two collecting screw conveyors.

and bearings, however, are of vital importance; the viscosity has a direct relation thereto.

Viscosity is a definite factor where enclosed crankcase, high-speed machines are used in connection with evaporating systems which may allow liquid refrigerant to return to the compressor, and dilute the oil therein.

With "Freon" refrigerants, methyl chloride or the Carrenes their mutual solubility with petroleum lubricating oils depends upon the physical nature of the refrigerant in question. When they are in the liquid phase, all are entirely miscible with petroleum oils. When such refrigerants are in the gas-

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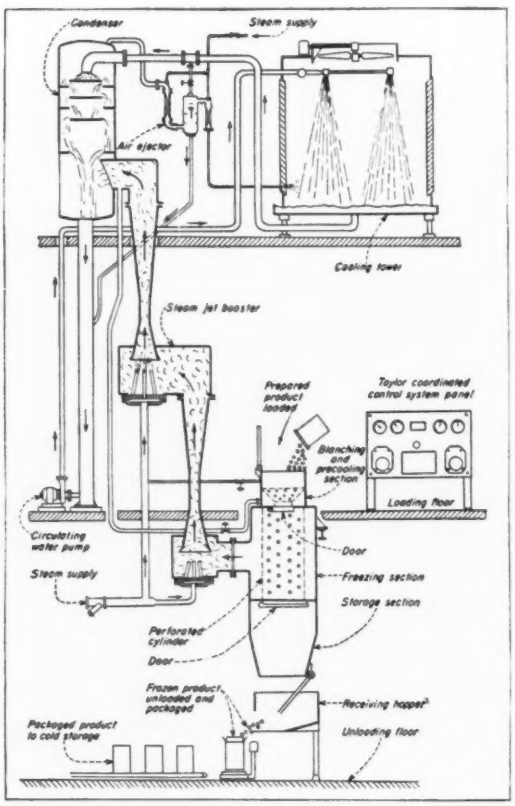
eous phase, however, the oil being almost entirely liquid absorbs only a small portion of the gas. In other words, the respective refrigerant vapors will go into solution less readily, dependent upon the prevailing pressures and temperatures.

The amount of any such refrigerant which may be absorbed by a mineral oil will be dependent also upon the viscosity of the oil at the temperature of contact. As the viscosity is increased the amount of refrigerant absorbed will decrease. In turn,



Courtesy of Ingersoll-Rand Company

Figure 9—The Ingersoll-Rand "Freez-Vac" system whereby freezing is done by flash evaporation.

larger amounts of "Freon," methyl chloride and Carrene are absorbed by mineral oils at higher pressures and lower temperatures, just as smaller amounts will be absorbed at lower pressures and higher temperatures.

The speed, the capacity and the type of compressor (whether air or water-cooled) principally will govern the viscosity of oil which should be used.

The one oil usually lubricates the entire machine, serving both the cylinders and the bearings. It should not emulsify to any great extent, for this might cause clogging of the lubricating system or impairment of refrigeration should oil or emulsions work past the piston rings and over to the refrigerating side.

The physical condition of the valves, piston rings and stuffing boxes must also be considered in deciding upon the viscosity of oil to use. Practically as important as its lubricating properties will be the seal maintaining ability. If the cylinder walls and moving parts are in first-class condition a straight mineral oil of from 150-300 seconds Saybolt viscosity at 100 degrees Fahr., should give adequate lubrication.

In large machines, or those where the cylinder walls are scored or rings are worn, an oil of somewhat higher viscosity may be essential to maintain the requisite seal and degree of compression. Under such conditions an oil having a viscosity around 300 or even 500 seconds Saybolt at 100 degrees Fahr., may give the best performance.

AUXILIARY EQUIPMENT

While the refrigerating unit is the most glamorous of the "back field" mechanisms required for frozen foods treatment, the "line" may include belt conveyors for freezer tunnel handling of packaged meats; the hydraulic jacks, plate suspension cables and door hinges of the quick-freezing unit; and the fans or blowers in a blast freezing installation.

To a varied degree these various mechanisms may be exposed to the freezing temperatures, in which case they present a lubrication problem because the lubricants must be chosen with care so that they will function properly when exposed to these temperatures.

Conveyor Bearings

The bearings of a freezer tunnel conveyor are a case in question. Here an average ambient temperature of around −20° Fahr. prevails. As the conveyor is usually of the belt type it is carried on conveyor rolls or idlers which must turn freely at these temperatures otherwise flow of the frozen packages may be retarded. It is most important to synchronize the rate of speed of the feeder conveyor with that of the freezer conveyor and the tail-off conveyor. The bearings of the feeder and tail-off conveyors will not cause much concern — they are located outside the freezer and any properly prepared ball or roller bearing grease will keep them running. In the freezer, however, we must consider the plasticity or shearing ability of the grease. It is not necessary for it to possess fluidity but it must shear or break away from itself readily so that there will be minimum starting and running torque.

This characteristic has been carefully considered by the grease chemist when selecting the ingredients and planning the method of preparation. It

is an inherent property of the modern mixed-base (sodium-lime soap) ball and roller bearing grease when an oil of sufficiently low viscosity is used and the grease is fortified by an anti-oxidant. This same grease is also suitable for the ball or roller bearings of blowers or fans in blast freezing.

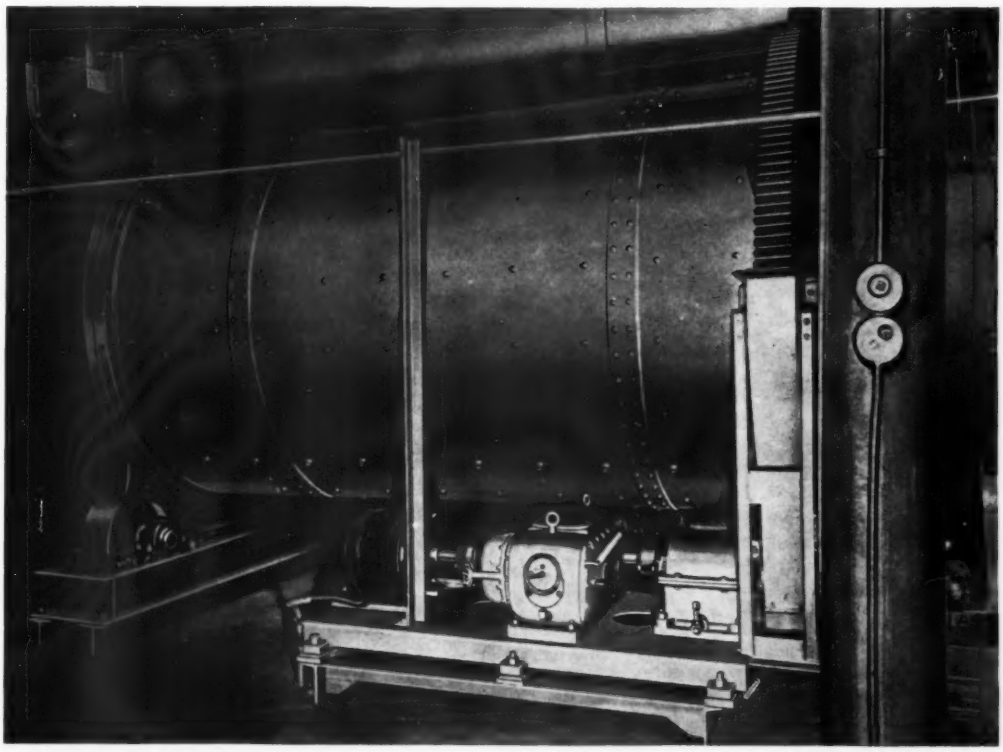
Hydraulic Operations

Hydraulic jacks are used in multiplate freezers for raising and lowering the freezing trays. The hydraulic pump and motor along with the hydraulic oil tank can be located below the freezing unit with piping to the hydraulic lift cylinder, or the pump and motor can be installed so as to operate a battery of freezing units. This latter is conventional practice today in modern quick-freezing where the entire installation is a stationary plant.

A comparatively low viscosity very highly refined hydraulic oil of from 100 to 150 seconds Saybolt Universal viscosity at 100° Fahr. is preferred. Such an oil should be fortified with rust and oxidation inhibitors to give maximum protection to the pump and motor mechanisms and other parts against rust and to retard development of oxidation products in the oil which might cause formation of gums and lacquers.

DEHYDRATION INVOLVES HEAT

In contrast with the freezing process, dehydration or partial drying of certain foods for the purpose of preservation involves shrinking of the cell structure and driving off of the water content. Dehydration and drying requires heat, hence the machinery involved is designed to function at elevated temperatures. Normally the range of temperature required for dehydration or evaporation will vary according to the type of foodstuff and design of the installation; it may vary from 200° to 700° Fahr. The process must be carried on at a controlled rate and not too rapidly, for excessively fast temperature rise might promote change in the cell structure. The temperature range will vary however, according to the moisture content of the foods involved and the degree of dehydration desired.



Courtesy of Link-Belt Corp.

Figure 10 — Showing the drive side of the Link-Belt Roto-Louvre dryer. The drive unit in the middle is a P.I.V. gear for regulating the speed of the dryer shell.

Dehydration, evaporation or drying is carried out in kilns or driers of varying design, again according to the type of food being treated. The actual machinery required involves the turning

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mechanisms for rotary driers, various types of conveyors for handling the product to and from the drying unit, fans for air circulation and motors for driving these units. Normally their temperatures of operation will not be extreme.

Bearings are of chief concern from a lubrication point of view; they may be sleeve type or involve ball or roller design according to the installation. As conveyors of the belt type are widely used, the rollers and idlers are extensively equipped with roller bearings. When ball or roller bearing fans and motors also are installed, grease lubrication prevails — the same grease — a high quality oxidation-resistant product being used.

Importance of the Conveyor

The conveyor is very important as correlating equipment in expediting handling of raw products from the receiving platform and thence to preparation machinery, elevating to upper levels where necessary, and charging to the kilns or evaporators. When modern methods of conveying were perfected, mass handling of fruits, milks, meats and fish became practicable. When conveyor bearings were studied with respect to housing design, seals and methods of lubrication, operation also became more dependable.

Conveyors of the belt or bucket type are widely used. The former is applicable to one level handling or to slight inclines; the latter for raising products from one floor level to another.

Pressure Grease Lubrication

Pressure grease lubrication is most generally provided for. The pressure grease gun is capable of handling greases of a considerable range of consistencies with adequate power to assure of complete coverage of the bearing elements, or in controlled volume according to the provision for bearing venting. It is especially applicable to the bearings of belt conveyor rolls and idlers where lubrication is applied from one or two points only, (for each set of rolls) i.e., at the end of one or both of the side rolls, with provision for distribution of grease through suitable ducts to the bearings of the center roll. Insurance against grease leakage is provided in some designs by labyrinth grease seals of the centrifugal type which keeps the grease in the bearing and prevents entry of dust or dirt. Bearings of fans and motors of similar design are lubricated in the same way.

Ring-Oiled Bearings

Ring-oiled plain bearings on some types of fans and motors must be oil lubricated. The ring which is suspended from the shaft turns freely thereon, serving as a means of automatic lubrication by continually carrying a certain amount of oil from the reservoir in the base up to the top of the shaft. Here it distributes itself by the turning of the shaft throughout the clearance space to form a highly dependable lubricating film. Ring oilers normally require a light medium viscosity machine oil of from 200 to 300 secs. Saybolt Universal viscosity.

Driving Gears

Gears may be exposed or enclosed according to their service. Conveyor reduction gear drives are very often enclosed in suitable housings which are oil-tight. The turning gears on some rotary dryers or kilns however, may be exposed. Enclosed gears are lubricated by a comparatively fluid gear lubricant which is capable of forming a film of ample film strength on the teeth. Exposed gearing requires a heavier lubricant which may have to be heated to facilitate application. Suitable gear lubricants are characterized by their ability to stick to the teeth, withstand pressure and shock loads, spread without dripping or throwing, and their resistance to oxidation and any washing effect of water.

CONCLUSION

Foodstuffs can be preserved and prepared for extended storage only so long as the machinery required for freezing, dehydration and handling is kept running in proper condition. There again, as in so many other industries, the unit cost of lubrication per ton of products handled, is relatively insignificant. It should never be allowed to influence the decision as to whether more costly, high quality lubricants are warranted. Their ability to keep the machinery operating economically is the best evidence in their favor.

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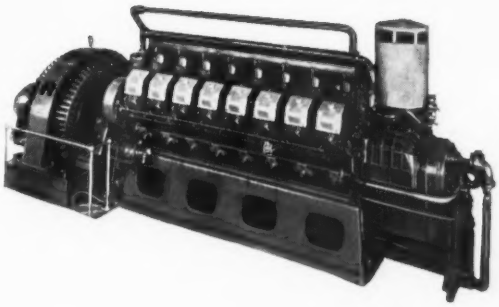

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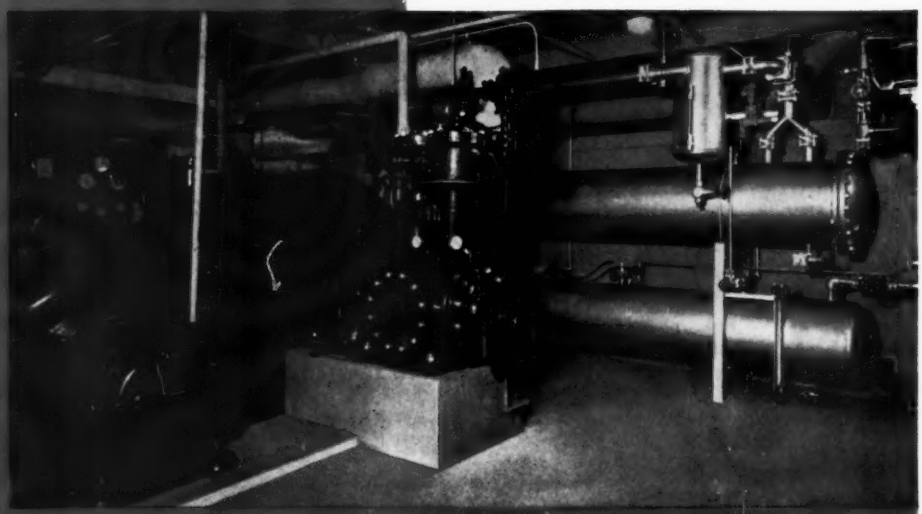

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